Shaughnessy No.: 099101

Date Out of EFGWB: FEB 23 1990

TO: P. Hundemann
Product Manager #74
Registration Division (H7505C)

FROM: Emil Regelman, Supervisory Chemist
Environmental Chemistry Review #2
Environmental Fate and Groundwater Branch/EFED (H7507C)

THRU: Hank Jacoby, Chief
Environmental Fate and Groundwater Branch
Environmental Fate and Effects Division (H7507C)

Hank Jacoby

Attached, please find the EFGWB review of:

Reg./File #(s): 257428

Common Name: Benomyl

Chemical Name: Methyl-1-(butylcarbamoyl)-2-benzimidazole

Type of Product: Fungicide

Product Name: Benelate, Tersan 1991, Benex

Company Name: E.I. duPont de Nemours & Co.

Purpose: Review of soil column leaching and rice paddy infiltration rate data in support of the aquatic field dissipation data requirement. Review of soil characteristics information in support of the mobility in soil data requirement.

Date Received: 1/5/90 Action Code: 660

EFGWB #(s): 90-0276

Total Reviewing Time: 3.0

Deferrals to: ______ Ecological Effects Branch/EFED

______ Science Integration & Policy/EFED

______ Non-Dietary Exposure Branch/HED

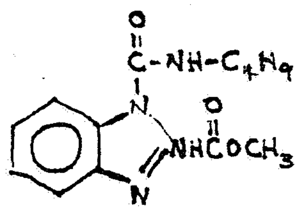
______ Dietary Exposure Branch/HED

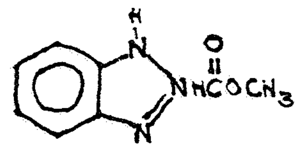
______ Toxicology Branch I/HED

______ Toxicology Branch II/HED

1. <u>CHEMICAL:</u>
Common Name: Benomyl
Chemical Name: Methyl-1-(butylcarbamoyl)-2-benzimidole
Type of Product: Fungicide
Trade Name: Benelate, Tersan 1991, Benex

Chemical Structures: Benomyl, carbendizam (the major degradate)





2. <u>TEST MATERIAL:</u>
See DER.

3. <u>STUDY/ACTION TYPE:</u>
Soil column leaching study and flooded rice growing soil infiltration rates in support of the aquatic field dissipation (164-2) data requirement. Characteristics of typical rice growing soils in support of the adsorption/desorption (163-1) data requirement.

4. <u>STUDY IDENTIFICATION:</u>

(1) Letter dated 11/7/89 from R. Hamlen of Du Pont to P. Hundemann of RD/OPP.

(2) MRID #41274801
Ryan D. 1989. Soil column leaching of [phenyl(U)-^{14}C]benomyl in a rice paddy soil. Completed on October 9, 1989. Performed and submitted by E.I. du Pont de Nemours and Company, Wilmington, DE. (included in a package with the 11/7/89 letter referenced above).

(3) Internal du Pont memo dated 10/11/89 from K. Monson to R. Hamlen. Attached to the memo were infiltration rate data for various rice fields (memo and attachment were included in a package with the 11/7/89 letter referenced above).

(4) Letter dated 8/11/89 from R. Hamlen of du Pont to J. Mitchell of RD/OPP. Attached to the letter are summaries of the characteristics of 7 typical rice growing soils (letter and attachment were included in a package with the 11/7/89 letter referenced above).

5. <u>REVIEWED BY:</u>
Henry Nelson, Ph.D., Chemist
Environmental Chemistry Review Section #2
Environmental Fate and Groundwater Branch/EFED

H Nelson
Date: 2/22/90

6. <u>APPROVED BY:</u>
Emil Regelman, Supervisory Chemist
Environmental Chemistry Review Section #2
Environmental Fate and Groundwater Branch/EFED

Date: FEB 23 1990

7. CONCLUSIONS:

(1) The supplemental unaged soil column leaching study (41274801, see attached DER) and infiltration rate data for flooded rice fields (see discussion) are acceptable for supplemental information. Along with previously reviewed (see EAB #6080 dated 4/4/86) soil column leaching (00151421, see attached Tables 1, 2, and 3) and batch equilibrium/soil TLC (00151422, see attached Tables 4, 5, and 6) studies, the supplemental information indicates that benomyl and its major degradate (carbendizam) are unlikely to be susceptible to leaching from flooded rice growing soils. Therefore, EFGWB concludes that study 00146415 satisfies the aquatic field dissipation data requirement for benomyl use on rice even though only the top 2 inches of soil were sampled.

(2) The comparison of the characteristics of the 4 test soils used in the batch equilibrium adsorption/desorption study to characteristics of 7 typical rice growing soils (Table 1) is acceptable for supplemental information. The comparison shows that from the standpoint of combined characteristics (texture, pH, and %OM together), the test soils do not represent typical rice growing soils very well. However, for unionized organics such as benomyl and its major degradate (carbendizam), the percentage organic matter is generally the most important factor affecting adsorption to soil. The range of organic matter for the test soils (1.1-7.5%) is comparable to that of the surface layers of 7 typical rice growing soils (0.9-6.0%). Furthermore, flooded rice growing soils are not really aquatic sediments. Therefore, the requirement for batch equilibrium data on the adsorption/desorption of benomyl to a rice growing soil/sediment is waived.

8. RECOMMENDATIONS:

Please inform the registrant that study 00146415 satisfies the aquatic field dissipation (164-2) data requirement for the use of benomyl on rice and that the requirement for batch equilibrium data on the adsorption/desorption of benomyl to a rice growing sediment is waived.

9. BACKGROUND:

Benomyl is a fungicide registered for use on a variety of food crops including rice, soybeans, apples, oranges, peaches, and pecans. Application rates range from 0.063 to 1.5 lbs ai/acre.

In a review dated 9/14/88, EFGWB (see EFGWB #80863) concluded that study 001464415 did not satisfy the aquatic field dissipation (164-2) data requirement because soil was sampled to a depth of only 2 inches. The registrant's argument that sampling below 2 inches was unnecessary because "data from the two silt loam soils (typical of Louisiana and Arkansas silt loam soils) studied in the submitted soil column leaching study (EPA Accession No. 259471) indicated that 98% and 93% of all residues were contained in the upper 2" of the soil column" was rejected by EFGWB for the following reason: The percent organic matter for the 2 silt loam soils cited in the cited leaching study (4.3 and 7.5%) were much higher than those studied in the aquatic field dissipation study (1.1 and 1.4%). In response the registrant has submitted an additional soil column leaching study (41274801) on a low organic rice growing soil and infiltration rate data for flooded rice fields to support their argument.

In the same review dated 9/14/88, EFGWB (see EFGWB #80863) rejected a waiver request for data on the adsorption/desorption of benomyl to a soil representative of rice growing areas for the following reason: The registrant did not submit soil characteristic information to support their claim that the characteristics of the 4 test soils used in the batch equilibrium adsorption/desorption study (00151422) were within the range of characteristics exhibited by typical rice growing soils. In response, the registrant has submitted a comparison of the characteristics of the 4 test soils to characteristics of 7 typical rice growing soils.

10. <u>DISCUSSION:</u>

(1) A comparison of the characteristics of 7 typical rice growing soils to those used in the adsorption/desorption study is presented in Table 7. The registrant's contention that the characteristics of soils used in the adsorption/desorption study are within the wide range of characteristics exhibited by typical rice growing soils is generally but not completely correct as can be seen from Table 7. The percentage organic matter of the Keyport silt loam test soil (7.5%) is greater than the maximum percentage organic matter (0.9-6.0%) for the 7 typical rice growing soils listed in Table 1. The range of pHs represented by the test soils (5.2-6.6) is substantially less than the range exhibited by the rice growing soils (4.5-8.4). In addition, in looking at combinations of characteristics, the 4 test soils do not appear to represent typical rice growing soils very well.

(2) It is unclear how the submitted infiltration rate data for various flooded rice paddies in Texas were derived. Table 22 provides evapotranspiration plus infiltration (column 4), evapotranspiration (column 5), and infiltration (column 6) data

for several flooded rice growing soils in Texas. The infiltration numbers in column 6 are generally not equal to the evapotranspiration plus infiltration numbers in column 4 minus the evapotranspiration numbers in column 5. Based upon the numbers in column 6, mean infiltration rates for various rice growing soils in Texas under flooded conditions ranged from 0.02 to 0.24 in./day averaging 0.093 in./day over 8 soils. Over a 90 day flood period, the corresponding total infiltration would range from 1.8 to 21.6 inches averaging 8.4 inches which is less than the 20 inches used in the soil column leaching studies.

(3) See the attached DER for a discussion on the supplemental soil column leaching study (41274801).

11. <u>COMPLETION OF ONE LINER:</u>
Not applicable.

12. <u>CBI INDEX:</u>
Not applicable.

Benomyl Sha# 099101

Page_____ is not included in this copy.

Pages 6 through 13 are not included.

The material not included contains the following type of information:

_____ Identity of product inert ingredients.

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DATA EVALUATION RECORD

SHAUGNESSY No. 99101
COMMON NAME: Benomyl
CHEMICAL NAME: Methyl-1-(butylcarbamoyl)-2-benzimidazole
FORMULATION: Active Ingredient
DATA REQUIREMENT: Soil Column Leaching (163-1)

MRID # 41274801
Ryan D. 1989. Soil column leaching of [phenyl(U)-^{14}C]benomyl in a rice paddy soil. Completed on October 9, 1989. Performed and submitted by E.I. du Pont de Nemours and Company, Wilmington, DE.

REVIEWED BY: Henry Nelson, Ph.D. Date: 2/22/90
TITLE: Chemist
ORGANIZATION: OPP
TELEPHONE: 557-2505

SIGNATURE: H Nelson

CONCLUSIONS:

(1) This supplemental unaged soil column leaching study (41274801) was submitted in support of the aquatic field dissipation data requirement, and is acceptable for that purpose.

(2) The equivalent of 2.2 lb ai/acre of ^{14}C-benomyl was applied to the top of a 12 inch soil column packed with a silty clay loam (pH = 7.3, OM = 0.9%). After elution with 20 inches of water under a constant head, the distribution of applied radioactivity was as follows: total soil column plus eluate (103.4%), 0-2 inch (93.9%), 2-4 inch (8.7%), 4-12 inches combined (< 1.0%), and eluate (0.34%). Based upon the results of hydrolysis, soil metabolism, and other soil column leaching studies, the study author postulated that most of the applied ^{14}C-benomyl had been hydrolyzed to ^{14}-carbendazim during the > 20 hour duration of the study. The results indicate that benomyl/carbendazim residues had extremely low mobility in the test soil. The test soil is reportedly typical of rice growing soils in Mississippi.

MATERIALS AND METHODS:

(1) Test Chemical:
[Phenyl(U)-^{14}C] benomyl (21.6 uCi/mg, radiochemical purity = 97%)

(2) Stock Solution:
Nominal 0.91 mg ^{14}C-benomyl/ml acetone (At the time of application to the soil column, 23% of the applied was accounted for by carbendazim).

14

(3) Test Soil:
Greenville, MS silty clay loam (pH = 7.3, OM = 0.9%). Other reported characteristics of the test soil are listed in Table I. Soil particles passing through a 2 mm sieve, but excluded from a 0.84 mm sieve were used in the study. Therefore, since the clay, silt, and fine sand fractions can pass through a 0.84 mm sieve, it is probable that the actual characteristics of the test soil are different than those listed in Table 1 (see discussion).

(4) Experimental Conditions:
The equivalent of 2.2 lbs ai/acre of ^{14}C-benomyl was applied to the top of a 12 inch soil column packed with sieved silty clay loam soil. The column was eluted with 20 inches of water under a constant head. Due to the low draining characteristics of the study soil, a microperistatic pump was used to draw water from the column at 50 mL/hr.

(5) Sampling and Analysis:
After the soil column was eluted with 20 inches of water, the soil within the 12 inch column was cut into 2 inch segments. Triplicate aliquots of each soil segment were analyzed for total radioactivity by combustion followed by LSC. Eluate fractions were analyzed for total radioactivity by LSC. Neither the soil segments nor the eluate were analyzed specifically for benomyl or its degradates such as carbendazim.

RESULTS:

The distribution of radioactivity between the eluate and soil column is presented in Table II. The distribution of radioactivity remaining in the soil column is presented in Table III.

Approximately 103.4% of the applied radioactivity was recovered. After elution of the soil column with 20 inches of water under a constant head, the distribution of applied radioactivity was as follows: total soil column plus eluate (103.4%), 0-2 inch (93.9%), 2-4 inch (8.7%), 4-12 inches combined (< 1.0%), and eluate (0.34%). Based upon the results of hydrolysis, soil metabolism, and other soil column leaching studies, the study author postulated that most of the applied ^{14}C-benomyl had been hydrolyzed to ^{14}-carbendazim during the > 20 hour duration of the study. The results indicate that benomyl/carbendazim residues had extremely low mobility in the test soil. The test soil is reportedly typical of rice growing soils in Mississippi.

DISCUSSION:

(1) The study would not partially satisfy the mobility in soil (163-1) data requirement because radiolabeled residues were not

15

analyzed specifically for benomyl and its degradates. In addition, soil particles passing through a 2 mm sieve, but excluded from a 0.84 mm sieve were used in the study. Therefore, the clay, silt, and fine sand fractions of the soil were removed from the soil prior to packing the column. However, the study was submitted to support the aquatic field dissipation (164-2) data requirement, not the mobility in soil data requirement.

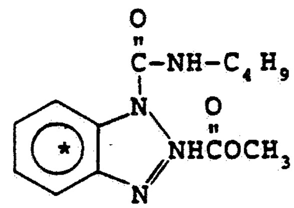
(2) Although the failure to analyze radiolabeled residues specifically for benomyl and its degradates is a serious deficiency, the results of soil column leaching studies on 4 other soils (see EAB No. 6080 dated 4/4/86) support the study author's assumption that most of the applied radioactivity at the termination of the study was probably accounted for by carbendazim.

(3) The study author did not explain why the clay, silt, and fine sand fractions were removed from the soil. It was probably an attempt to present a worst case estimate of mobility in an aquatic sediment. Due to the greater settling velocities of larger particles and the typical formation of suspended clay colloids in surface waters, sediments typically have much higher percentages of course sand and much lower percentages of clay, silt, and fine sand then do the soils from which they originate. However, a flooded rice growing soil is not an aquatic sediment. Nevertheless, the removal of the clay, silt, and fine sand fractions probably reduced the adsorption capacity of the soil due to a decrease in surface area and a probable decrease in the percentage of soil accounted for by humic materials (humic materials are typically preferentially bound by the smaller soil fractions). Therefore, even though the removal of the clay, silt, and fine sand fractions from the test soil probably does not simulate flooded rice growing soil, it probably does provide a worst case estimate of leaching potential.

(4) The test soil used in the soil column leaching study (a Mississippi silty clay loam with pH = 7.3 and OM = 0.9%) was submitted to support an aquatic field dissipation study on a Louisiana silt loam (pH = 6.6, OM = 1.0%) and an Arkansas silt loam (pH = 6.2, OM = 1.4%). No explanation was provided on the use of a different soil for the soil column leaching study. In addition, the characteristics provided for the Mississippi silt clay in Table I are not those of the test soil since the clay, silt, and fine sand fractions were removed prior to packing the column.

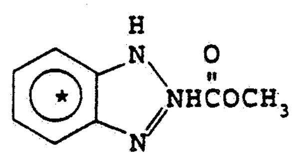
FIGURE 1

CHEMICAL STRUCTURES OF BENOMYL AND CARBENDAZIM



Benomyl

Methyl 1-(butylcarbamoyl)-2-benzimidazole carbamate



Carbendazim

Methyl 2-benzimidazole carbamate

* denotes location of ^{14}C-label

Benomyl Sha# 099101

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Pages 18 through 22 are not included.

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